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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/567,929	11/09/2006	Michael Duerr	285450US8X PCT	5376

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OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER	
HO, ANTHONY	
ART UNIT	**PAPER NUMBER**
2815	

NOTIFICATION DATE	DELIVERY MODE
10/04/2011	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@oblon.com
oblonpat@oblon.com
jgardner@oblon.com

Office Action Summary	Application No.	Applicant(s)	
	10/567,929	DUERR ET AL.	
	Examiner	Art Unit	
	ANTHONY HO	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 June 2011*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-6,9-13 and 15-29* is/are pending in the application.

5a) Of the above claim(s) *15,19,25 and 26* is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-6,9-12,16-18,20-24,27 and 29* is/are rejected.

8)☒ Claim(s) *13 and 28* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on June 10, 2011 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-6, 9, 10, 13, 16-18, 21-24, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kymakis et al, "Single-Wall Carbon Nanotube/Conjugated Polymer Photovoltaic Devices," Applied Physics Letters, American Institute of Physics. New York, US, vol. 80, no. 1, 7 January 2002 (2002-01-07), pages 112-114 with support of Dukovic et al, "Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes," Nano Letters, Vol. 5, No. 11 (pp. 2314-2318) 2005 (teaching reference) in view of Tsukamoto et al (US PUB 2004/0241900).

In re claims 1 and 27, Kymakis et al discloses a photovoltaic device, comprising a composition of carbon nanotubes and of at least one organic compound (Figure 1; page 112, column 1, lines 24-26).

Dukovic et al teaches the band gap of SWNTs are dependent upon the diameter of the carbon nanotubes and are defined by equation (4) – band gap = $(0.34\ eV/d_t) + (1.11\ eV/(d_t + 0.11))$ (i.e. page 2317, first column).

Kymakis et al discloses using SWNTs, in which their diameter is 1.4 nm (i.e. page 112, second column). Substituting 1.4 nm for d_t in equation (4) above, the band gap obtained is 0.978 eV.

Thus, Kymakis et al has a composition of carbon nanotubes (in this case, SWNTs), wherein the band gap of said carbon nanotubes lies in the range of from about 0.5 to about 1 eV (in this case, the band gap is 0.978 eV).

Kymakis et al does not disclose a band gap of the at least one organic hole conductor is in a range of from 1.75 to 2.25 eV.

However, Tsukamoto et al discloses carbon nanotubes dispersed in a polymer in an organic electronic device wherein the polymer used is polythiophene (i.e. paragraph 0035). Since Tsukamoto et al uses polythiophene, the same material as in the instant application, Tsukamoto et al discloses having an organic hole conductor that has a band gap in a range from 1.75 to 2.25 eV.

Furthermore, one of ordinary skill in the art would be motivated to use a material with low band gap because of the faster electron transfer from LUMO to HUMO in the material.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the photovoltaic device as taught by Kymakis et al with support of Dukovic et al with carbon nanotubes dispersed in a polymer in an organic electronic device wherein the polymer used is polythiophene as taught by Tsukamoto et al in order to use a material with low band gap because of the faster electron transfer from LUMO to HUMO in the material.

In re claim 2, Kymakis et al discloses the first and second electrodes are made of ITO and aluminum (page 113, column 2, line 9).

In re claim 3, Kymakis et al discloses the material used in the device is P3OT.

In re claim 4, Kymakis et al discloses the carbon nanotubes are semiconducting carbon nanotubes (page 112, column 1, line 36 – column 3, line 2).

In re claim 5, Kymakis et al discloses the carbon nanotubes are single-walled carbon nanotubes (page 112, column 2, line 5).

In re claim 6, Kymakis et al discloses the carbon nanotubes have a diameter of 1.4 nm (page 112, column 2, line 9).

In re claim 9, Kymakis et al discloses the LUMO of P3OT is 2.85 eV (page 114, column 1, lines 29-30), its bandgap 2.4 eV (page 113, column 1, line 24), addition of these values results in a HOMO of 5.25 eV which is greater than the HOMO of the carbon nanotubes (page 114, column 1, lines 16-17).

In re claim 10, Kymakis et al discloses the composition comprises a mixture of carbon nanotubes and at least one hole conductor (page 112, column 2, lines 5-17).

In re claim 16, Kymakis et al does not wherein the at least one organic hole conductor is selected from the group listed.
However, Tsukamoto et al discloses carbon nanotubes dispersed in a polymer in an organic electronic device wherein the polymer used is polythiophene (i.e. paragraph 0035).
The advantage to use a material with low band gap is because of the faster electron transfer from LUMO to HUMO in the material.
Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the photovoltaic device as taught by Kymakis et al with support of Dukovic et al with carbon nanotubes dispersed in a polymer in an organic electronic device wherein the polymer used is polythiophene as taught by Tsukamoto et al in order to use a material with low band gap because of the faster electron transfer from LUMO to HUMO in the material.

In re claim 17, the recitation "wherein it is an organic solar cell" in the claim preamble specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

In re claim 18, Kymakis et al discloses the one of the electrodes is a film or layer of a transparent material, ITO.

In re claim 21, Kymakis et al discloses a glass substrate (i.e. Figure 1).

In re claim 22, it is well known in the art that a flexible polymer substrate is used in photovoltaic devices.

In re claim 23, the recitation "a combination of the device according to claim 1 with a circuit, wherein the device acts as an internal power supply" in the claim

preamble specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

In re claim 24, the recitation “a solar cell” in the claim preamble specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

4. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kymakis et al, "Single-Wall Carbon Nanotube/Conjugated Polymer Photovoltaic Devices," Applied Physics Letters, American Institute of Physics. New York, US, vol. 80, no. 1, 7 January 2002 (2002-01-07), pages 112-114 with support of Dukovic et al, "Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes," Nano Letters, Vol. 5, No. 11 (pp. 2314-2318) 2005 (teaching reference) in view of Tsukamoto et al (US PUB 2004/0241900) as applied to claim 1 above, and further in view of Forrest et al (US Patent 6,451,415).

5. Kymakis et at, with support of Dukovic et al, as modified by Tsukamoto et al, as discussed above, does not disclose a multilayer structure for photovoltaic devices.

6. However, Forrest et al discloses a multilayer structure for photovoltaic devices (Figure 2D).

7. The advantage is for efficient charge carrier generation (column 8, lines 51-65).

8. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the photovoltaic device as taught by Kymakis et al with support of Dukovic et al with a multilayer structure for photovoltaic devices as taught by Forrest et al in order for efficient charge carrier generation.

9. Claims 20 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kymakis et al, "Single-Wall Carbon Nanotube/Conjugated Polymer Photovoltaic Devices," Applied Physics Letters, American Institute of Physics. New York, US, vol. 80,

no. 1, 7 January 2002 (2002-01-07), pages 112-114 with support of Dukovic et al, "Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes," Nano Letters, Vol. 5, No. 11 (pp. 2314-2318) 2005 (teaching reference) in view of Tsukamoto et al (US PUB 2004/0241900) as applied to claim 2 above, and further in view of Ganzorig et al, "Alkali metal acetates as effective electron injection layers for organic electroluminescent device," Materials Science and Engineering B, Elsevier Sequoia, Lausanne, Ch, vol. 85, no. 2-3, 22 August 2001 (2001-08-22), pages 140-143.

10. In re claim 20, Kymakis et at, with support of Dukovic et al, as modified by Tsukamoto et al, as discussed above, does not disclose the addition of an LiF, CsF or Li-acetate interlayer between the Al electrode and the organic hole conducting compound layer.

11. However, Ganzorig et al discloses the addition of an LiF, CsF or Li-acetate interlayer between the Al electrode and the organic hole conducting compound layer (Abstract).

12. The advantage is to lower the work function of the Al layer and thus enhance hole transfer from the organic compound to the Al electrode (Abstract).

13. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the photovoltaic device as taught by Kymakis et al with support of Dukovic et al with the addition of an LiF, CsF or Li-acetate interlayer between the Al electrode and the organic hole conducting compound layer as

taught by Ganzorig et al in order to lower the work function of the Al layer and thus enhance hole transfer from the organic compound to the Al electrode.

14. In re claim 29, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the layer of fluoride or acetate have a thickness of 0.1 nm to 2 nm, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller,* 105 USPQ 233.

Response to Arguments

15. Applicant's arguments with respect to claims 1-6, 9-12, 16-18, and 20-24 have been considered but are moot in view of the new ground(s) of rejection.

Allowable Subject Matter

16. Claims 13 and 28 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

17. The following is a statement of reasons for the indication of allowable subject matter: The prior arts of record do not disclose or suggest at least the limitations of “a photovoltaic device wherein said carbon nanotubes are vertical with respect to one of the electrodes” as recited in claim 13, and “a photovoltaic device wherein said carbon nanotubes have a length of between 100 nm and 500 nm” as recited in claim 28.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANTHONY HO whose telephone number is (571)270-1432. The examiner can normally be reached on Monday to Friday: 10AM - 6:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Anthony Ho/
Examiner, Art Unit 2815